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# Biotic characteristics of Ordovician deep-water cherts from Eastern Australia

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ABSTRACT

Early to Middle Ordovician cherts and cherty siltstones associated with distal turbidite deposition in back-arc basins, are widespread in the Hermidale and Albury–Bega Terranes of the Lachlan Orogen in New South Wales. Study of more than 2500 bedding plane-parallel thin sections prepared to a thickness of 50 μm from these cherts enables recognition of four conodont zones that range in age from the late Tremadocian to latest Darriwilian. Comparable cherts are present in two small remnants of oceanic derivation now exposed on the coast of New South Wales, in the Narooma Terrane (Furongian to Darriwilian), and in the New England Orogen at Port Macquarie in allochthonous blocks (Late Ordovician). Associated fauna include radiolaria, sponge spicules, lingulide and acrotretide brachiopods, fragmentary graptolites, and rare filaments attributed to cyanobacteria. Some of these organisms were pelagic, or may have been attached to floating material, and hence became entrapped in siliceous ooze on the sea floor when they settled under gravity. Others (e.g. the brachiopods) may have been attached to sponges growing on the sea floor. The presence of burrows and bioturbation demonstrates that the deep-sea environment in the Middle Ordovician was well-oxygenated, though this contrasts with Lower Ordovician environments where evidence for infauna is lacking. Predominant colouration of the cherts examined in thin section ranges from honey and yellow-brown (typical of semitransparent cherts) through cream-coloured translucent lithologies to opaque varieties. Dark brown cherty rocks that show evidence of burrowing or bioturbation tend to have a higher silt component. The Ordovician is also a time of extensive chert deposition elsewhere, including terranes in Kazakhstan (commencing in the Late Cambrian); these siliceous sediments display many of the features described from eastern Australia.



## 1. Introduction

Cherts and associated siliceous siltstones attain their maximum development in south-eastern Australia during the Early and Middle Ordovician, when they are widespread in the Lachlan Orogen of central and southern New South Wales (NSW), extending to the south into the northeast corner of the adjacent state of Victoria (Fig. 1). Such lithologies are also characteristic of largely contemporaneous (and also slightly older) strata of the exotic Narooma Terrane exposed on the south coast of NSW. Analogies can also be drawn between these rocks and extensive chert deposits, also of Early to Middle Ordovician age, known from terranes in Kazakhstan. Similar biotic characteristics typify such cherts, suggesting that a distinctive chert facies with a diagnostic faunal association was widespread in Ordovician deep-sea environments. Unusual features of this facies include its duration over many millions of years, leading to deposition of bedded cherts in some cases more than 50 m thick, preservation of a sample of the deep-sea pelagic biota prevalent at the time, and evidence of well-oxygenated environments at the bottom of the sea.

Cherts from both regions have been studied over the past 15 or more years by preparation of 50 micron-thick sections and polished section techniques. In Australia, these techniques were pioneered by Ian Stewart of Monash University (Victoria). Methods of thin section manufacture have been refined over the past decade in the Geological Survey of NSW, where more than 2500 sections have been prepared from chert samples mainly collected during regional mapping programmes in the Lachlan Orogen. These sections are cut parallel to bedding planes in order to maximise the chance of intersecting accumulations of pelagic or neritic biota that have passively fallen on to the sea floor.

## 2. Geological setting of chert facies in south-eastern Australia

New terminology has recently been introduced (Glen et al., 2009) for Ordovician terranes in the Lachlan Orogen. Within NSW, these include the Albury–Bega Terrane (incorporating turbidite-dominated successions and overlying Late Ordovician black shales west and east of the Macquarie Arc), and the Hermidale Terrane (represented by the Girilambone Group in central NSW). Restricted to a small area of exposure on the far south coast of the state, the Narooma Terrane (Glen et al., 2004) received predominantly siliceous deposition from Furongian (Late Cambrian) to late Darriwilian times, prior to

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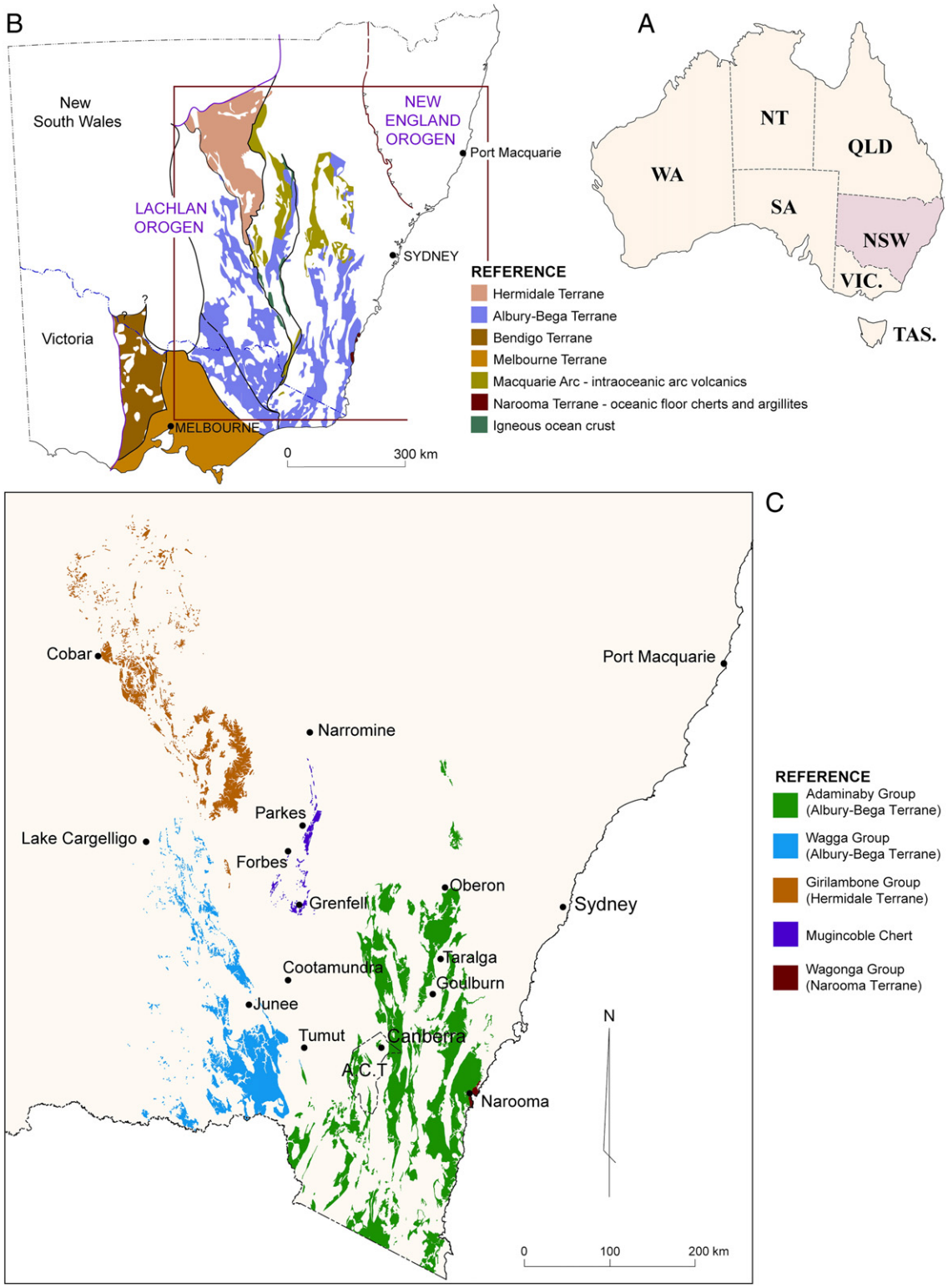


**Fig. 1.** A. Map of Australia showing location of New South Wales (NSW), relative to other states (VIC = Victoria, TAS = Tasmania, QLD = Queensland, SA = South Australia, WA = Western Australia) and territories (NT = Northern Territory). B. Distribution of Ordovician sedimentary and volcaniclastic rocks in the Lachlan Orogen of the southeastern Australian mainland; Ordovician rocks of the New England Orogen and Narooma Terrane are too small to shown at this scale. C. Distribution of chert-bearing stratigraphic units in the Lachlan Orogen and Narooma Terrane (see Reference for colour coding). Note that cherts and related siliceous sediments make up only a very small proportion of these rocks, and it would be impossible to show the distribution of pre-Sandbian cherts at this scale. Cities and towns on the map face are referred to in the text.

being accreted to the Albury–Bega Terrane during the Late Ordovician. The Port Macquarie Block of the New England Orogen, located on the mid North Coast of NSW, includes Late Ordovician cherts as a minor component; these are younger than those of the Lachlan Orogen and represent a sliver of ocean floor. The geographic distribution in NSW of Ordovician rocks that include chert horizons, and their relation to now-adjacent terranes, is depicted in Fig. 1. Their stratigraphic context (Fig. 2) is discussed below. Percival et al. (2011)